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UNITED STATES PATENT APPLICATION

OF

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FOR

WASHING MACHINE

[0001] This application claims the benefit of Korean Application(s) No. 10-2002-0075003 filed on November 28, 2002 which is/are hereby incorporated by reference.

BACKGROUND OF THE INVENTION

Field of the Invention

[0002] The present invention relates to a washing machine, and more particularly, to a washing machine having a brake resistance assembly of which stability is enhanced.

Discussion of the Related Art

[0003] Generally, a washing machine is categorized into a clutch drive type and a direct drive type according to a power transfer method. In the clutch drive type washing machine, a rotational force generated from a motor is transferred to a pulsator via a clutch. In the direct drive type washing machine, a drum is directly rotated using a dynamic force of a wash motor.

[0004] In this case, since the pulsator is driven only in the clutch type washing machine, the wash motor has to rotate at high sped to provide a strong current of water inside the drum. In doing so, friction between the pulsator and the laundry causes damage to the laundry as well as makes loud noise. Hence, the direct drive type washing machine is mainly used lately, in which BLDC (brushless direct current) motor driven by an inverter method for an efficient operation of the wash motor is used.

[0005] If a user opens a cover of the washing machine or the wash motor is abruptly braked while the inverter washing machine operates, the wash motor that is rotating at high speed makes a precipitate stop.

[0006] However, a rotor provided inside the wash motor keeps rotating due to inertia. In doing so, the wash motor operates as a generator to generate a counter electromotive force.

A voltage of the counter electromotive force is very high, thereby causing damage to electronic or electric circuits of the washing machine and further disabling the washing machine.

SUMMARY OF THE INVENTION

[0007] Accordingly, the present invention is directed to a washing machine that substantially obviates one or more of the problems due to limitations and disadvantages of the related art.

[0008] An object of the present invention, which has been devised to solve the foregoing problem, lies in providing a washing machine, by which a drive circuit of the washing machine is prevented from being damaged by a counter electromotive force generated from a wash motor making a precipitate stop.

[0009] Additional features and advantages of the invention will be set forth in the description which follows, and in part will be apparent to those having ordinary skill in the art upon examination of the following or may be learned from a practice of the invention. The objectives and other advantages of the invention will be realized and attained by the subject matter particularly pointed out in the specification and claims hereof as well as in the appended drawings.

[0010] To achieve these objects and other advantages in accordance with the present invention, as embodied and broadly described herein, there is provided a washing machine including a cabinet, a drum, a motor, and a brake resistance assembly including a case forming an exterior, first and second connect terminals fixed to the case to be connected to an external circuit, first and second bobbins provided in the case, and first and second coils differing in resistance to be wound on the first and second bobbins, respectively.

[0011] In this case, one ends of the first and second coils are connected to the first and second connect terminals, respectively and the other ends of the first and second coils are connected to a common terminal. The first coil is thinner than the second coil, or the resistance of the first coil is greater than the second coil.

[0012] Preferably, the first and second coils are formed of Al and Cu, respectively.

[0013] The brake resistance assembly further includes a common terminal connected to the other ends of the first and second coils, and a rugged part is formed on an outside of the case to increase a heat-exchange area thereof.

[0014] Moreover, the case includes a first partition having the first and second connect terminals fixed thereto and a second partition leaving a predetermined distance from the first partition.

[0015] A space between the first and second partitions in the case is filled up with an insulator having good heat conductivity, and a molding material is provided to outsides of the first and second partitions in the case.

[0016] In another aspect of the present invention, there is provided a brake resistance assembly including a case forming an exterior, first and second connect terminals fixed to the case to be connected to an external circuit, first and second bobbins provided in the case, and first and second coils differing in resistance to be wound on the first and second bobbins, respectively.

[0017] In this case, the elements of the brake resistance assembly are equivalent to those of the washing machine.

[0018] It is to be understood that both the foregoing explanation and the following detailed description of the present invention are exemplary and illustrative and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this application, illustrate embodiment(s) of the invention and together with the description serve to explain the principle of the invention. In the drawings:

[0020] FIG. 1 is a diagram of a drive circuit of a washing machine according to the present invention;

[0021] FIG. 2 is a cross-sectional view of a brake resistance assembly of a washing machine according to one embodiment of the present invention;

[0022] FIG. 3 is a layout of a brake resistance assembly of a washing machine according to the present invention; and

[0023] FIG. 4 is a cross-sectional view of a brake resistance assembly of a washing machine according to another embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT(S)

[0024] Reference will now be made in detail to the preferred embodiment(s) of the present invention, examples of which are illustrated in the accompanying drawings. Throughout the drawings, like elements are indicated using the same or similar reference designations where possible.

[0025] FIG. 1 is a diagram of a drive circuit of a washing machine according to the present invention.

[0026] Referring to FIG. 1, a drive circuit of a wash motor includes a converter unit 4, a switching mode power supply (hereinafter abbreviated SMPS) 6, a motor drive unit 8, a

microcomputer 14, an insulator gate bipolar transistor (hereinafter abbreviated IGBT) 12, a voltage comparison unit 10, and a brake resistance assembly 20.

[0027] The converter unit 4 includes a converter 4a converting AC current supplied from an external power source 2 to DC current and a capacitor C1. A switch 2a is provided between the power source 2 and the converter unit 4 to turn on/off the power source 2, and the SMPS 6 transforms the power to be appropriate for the wash motor 1 by the converter unit 4.

[0028] A relay 6a is provided between the SMPS 6 and the power source 2 to cut off the power 2 if a high frequency over a commercial frequency is inputted. A resistor R1 is connected to the relay 6a in parallel.

[0029] The motor drive unit 8 drives the wash motor 1 by the power transformed by the SMPS 6, and the microcomputer 14 controls a drive of the wash motor 1. The voltage comparison unit 10 compares a size of a counter electromotive force in braking the motor 1 to a reference voltage to transfer the result to the microcomputer 14.

[0030] Meanwhile, the IGBT 12 modulates pulse width according to a control signal of the microcomputer 14. Moreover, the IGBT 12 cuts off the power to the brake resistance assembly 20 on normal operation of the motor 1 or transfers the counter electromotive force to the brake resistance assembly 20 on the precipitate stop of the motor 1. In this case, the brake resistance assembly 20 consumes the counter electromotive force generated from the wash motor 1 in precipitate stop.

[0031] FIG. 2 is a cross-sectional view of a brake resistance assembly of a washing machine according to one embodiment of the present invention.

[0032] Referring to FIG. 2, the brake resistance assembly 20 includes a case 21, first and second connect terminals 27 and 28, first and second bobbins 32 and 35, and first and second coils 33 and 36.

[0033] The case 21 forms an exterior, and first and second partitions 25a and 25b are provided in the case 21 to leave a predetermined distance from each other. The first and second connect terminals 27 and 28 are provided to the first partition 25a to be connected to an external circuit. The first and second bobbins 32 and 35 are provided parallel between the first and second partitions 25a and 25b. And, the first and second coils 33 and 36 are wound on outer circumferences of the first and second bobbins 32 and 35, respectively.

[0034] One end of the first coil 33 is connected to the first connect terminal 27, and one end of the second coil 36 is connected to the second connect terminal 28. The other ends of the first and second coils 33 and 36 are connected to a common terminal 38. Moreover, the case 21 is filled up with an insulator 42 for insulating the first and second coils 33 and 36 from each other.

[0035] Hence, the counter electromotive force generated from the wash motor is inputted to the first and second coils 33 and 36 via one of the connect terminals 27 and 28. In this case, the coils 33 and 36 work as resistors so that the counter electromotive force passes through the coils 33 and 36 to be transformed into thermal energy. Hence, the voltage of the counter electromotive force drops to prevent the drive circuit of the washing machine from being damaged.

[0036] Meanwhile, in the brake resistance assembly 20 of the washing machine according to one embodiment of the present invention, the coils may be overheated to be damaged or to set on fire in case that an overvoltage exceeding a predetermined voltage is applied to the coils. The overheated coils cause damage to the circuit of the IGBT ('12' in FIG. 1). If the IGBT is damaged, it is unable to drive the washing machine.

[0037] FIG. 3 is a layout of a brake resistance assembly of a washing machine according to the present invention and FIG. 4 is a cross-sectional view of a brake resistance

assembly of a washing machine according to another embodiment of the present invention.

[0038] Referring to FIG. 3 and FIG. 4, the brake resistance assembly includes a case 51, first and second connect terminals 57 and 58, first and second bobbins 62 and 65, and first and second coils 63 and 66.

[0039] The case 51 of the brake resistance assembly 50 has a box figure. Locking holes 51a are formed at both ends of the case 51 to lock the case 51 to one side of the washing machine and a rugged part 53 is formed on an outer surface of the case 51 to increase a heat-exchange area.

[0040] First and second partitions 55a and 55b are provided in the case 51 to leave a predetermined distance from each other. The first and second connect terminals 57 and 58 are fixed to the first partition 55a. Namely, the first and second connect terminals 57 and 58 penetrate the first partition 55a to protrude to a predetermined length each, and the protruding portions are electrically connected to an external circuit.

[0041] In this case, the counter electromotive force generated from the motor in the precipitate stop is inputted to the second connect terminal 58, passes though the second coil 66 and the first coil 63 in turn, and it then outputted from the first connect terminal 57.

[0042] Meanwhile, the first and second bobbins 62 and 65 having a rod figure each are provided parallel between the first and second partitions 55a and 55b.

[0043] The first and second coils 63 and 66 are wound on outer circumferences of the first and second bobbins 62 and 65, respectively. One end of the first coil 63 is connected to the first connect terminal 57, and one end of the second coil 66 is connected to the second connect terminal 58. And, the other ends of the first and second coils 63 and 66 are electrically connected to a common terminal 38.

[0044] A voltage of the counter electromotive force generated from the motor making

a precipitate stop is high. The high voltage is inputted to the second coil 66 via the second connect terminal 58. In doing so, the counter electromotive force passes through the second coil 66 to be transformed into heat energy. Namely, the second coil 66 works as a resistor to drop the voltage.

[0045] Thereafter, the dropped voltage is inputted to the first coil 63 working as a resistor as well. Hence, the counter electromotive force is transformed into the heat energy to be almost vanished.

[0046] In this case, the voltage of the first coil 63 is lower than that of the second coil 66. Hence, a resistance of the first coil 63 needs not to be equal to that of the second coil 66. Preferably, the first coil 63 differs from the second coil 66 in resistance.

[0047] In case that the resistance of the first coil 63 is smaller than that of the second coil 66, the first coil 63 is formed thinner than the second coil 66 since resistance is in proportion to a cross-sectional area or length of a coil made of the same material.

[0048] When the motor makes the precipitate stop, the counter electromotive force passes through the second coil 66 prior to the first coil 63 so that its voltage drops. The dropped voltage is then inputted to the first coil 63. Hence, the resistance of the first coil 63 is formed greater to increase an exothermic amount.

[0049] In case that the voltage of the counter electromotive force is excessively high, the dropped voltage having passed through the second coil 66 is maintained relatively high. Subsequently, if the relatively high voltage is inputted to the first coil 63, the first coil having the high resistance is overheated. In this case, the first coil 63, if it is heated over a predetermined degree, melts to be cut off like a fuse, thereby preventing the overheated brake resistance assembly from causing damage to the drive circuit of the motor or setting on fire.

[0050] Moreover, if the first coil 63 is cut off, the counter electromotive force is

unable to be transferred to the drive circuit of the motor.

[0051] Meanwhile, it is also possible that the first coil 63 is formed of a material having a resistance greater than that of the second coil 66. Namely, the second coil 66 is formed of a Cu-based material, whereas the first coil 63 is formed of an Al-based material. Hence, an exothermic amount of the first coil 63 according to the current of the counter electromotive force is greater than that of the second coil 66. Thus, the first coil 63 is melted by the exothermic amount over a limit to prevent the overall system from being damaged.

[0052] Meanwhile, a molding material 70 is provided outside the first and second partitions 55a and 55b to fix the first and second connect terminals 57 and 58 and the common terminal 68. The molding material is formed of a material having low heat conductivity to delay the heat transfer that the heat generated from the coils 63 and 66 is transferred to the connect terminals 57 and 58.

[0053] A space provided between the partitions 55a and 55b inside the case 51 is filed up with an insulator 72 electrically insulating the coils 63 and 66 from each other. Preferably, the insulator is a material having excellent heat conductivity to quickly dissipate the heat of the coils 63 and 66 outside.

[0054] Moreover, in order to quickly dissipate the heat transferred from the insulator into the air, a rugged part 53 is formed on an outside of the case 51.

[0055] An operation of the washing machine having the brake resistance assembly is explained by referring to FIG. 3 and FIG. 4 as follows.

[0056] First of all, in case that a user opens a cover or makes a precipitate stop of the motor while the washing step is executed, the motor rotating at high speed makes the precipitate stop. Yet the rotor provided in the motor keeps rotating by inertia. Hence, the motor works as a generator to generate the counter electromotive force of high voltage. And,

the counter electromotive force is then supplied to the brake resistance assembly 50.

[0057] The counter electromotive force supplied to the brake resistance assembly 50 passes through the first and second coils 63 and 66 to be vanished into thermal energy. Moreover, if a voltage over a predetermined level is applied to both ends of the second coil, the second coil is cut off like a fuse. Hence, the drive circuit of the motor is prevented from being damaged by the precipitate stop of the motor.

[0058] Accordingly, the brake resistance assembly of the washing machine has the following advantages or effects.

[0059] First of all, one of a plurality of coils, which are provided in the brake resistance assembly to be connected to the motor, has a resistance greater than that of each of the rest coils. If the overvoltage due to the counter electromotive force is inputted, the coil having the greatest resistance melts to be cut. Therefore, the present invention prevents the damage of the peripheral circuit or fire caused by the overheated coil.

[0060] Moreover, the coil is cut when the overvoltage of the counter electromotive force takes place, whereby the IGBT is previously prevented from being broken.

[0061] It will be apparent to those skilled in the art that various modifications and variations can be made in the present invention without departing from the spirit or scope of the invention. Thus, it is intended that the present invention cover such modifications and variations, provided they come within the scope of the appended claims and their equivalents.